In the Claims

Claim 1-11 (cancelled).

12. (original) A method of capturing gas phase pollutants in a combustion system comprising the steps of:

creating a computer model of the combustion system for modeling various parameters in the combustion system, including flow patterns, temperature patterns, and condensation reactions;

using the computer model to predict the impact on gas phase pollutants by injecting particles into the combustion system, and to predict the impact on gas phase pollutants by the particle size distribution and the amount of injected particles in order to reduce the pollutants to a desired level;

using the computer model to determine one or more optimal locations in the combustion system for the injection of particles;

using the computer model to determine an optimal size and amount of particles to be injected; and

injecting the determined amount and size of particles into the combustion system at one or more of the determined locations to capture gas phase pollutants in the combustion system.

13. (original) The method of claim 12, wherein the combustion system includes an air preheater.

14. (original) The method of claim 12, wherein the gas phase pollutants include sulfur trioxide.

15. (original) The method of claim 14, wherein the temperature gradients within the air preheater are modified to increase the rate of sulfur trioxide condensation on ash particles as they pass through the air preheater and continue to travel downstream.

16. (original) The method of claim 12, wherein the model takes into account the fuel type used in the combustion system.

17. (original) The method of claim 12, wherein the model takes into account the geometry of the combustion system.

18. (original) The method of claim 12, wherein the optimal locations are determined based on where pollutant condensation occurs in the combustion system.

19. (original) The method of claim 12, wherein the model models rates of reaction of components.

Claim 20-58 (cancelled).

59. (previously presented) A method of capturing gas phase pollutants in a combustion system downstream of a combustion zone comprising:

creating a computer model of the combustion system that predicts the temperature gradient and location in the combustion system where the critical phenomena of condensation of gas phase pollutants occur; and

using the computer model to predict the effect of modifications to the combustion system, wherein the size distribution of resultant ash particles in the combustion system has an

increased population of fine particles below 5 microns compared to the combustion system without the modifications.

60. (previously presented) The method of claim 59, wherein the gas phase pollutants include sulfur trioxide.

61. (previously presented) The method of claim 60, wherein the temperature gradients within the air preheater are modified to increase the rate of sulfur trioxide condensation on ash particles as they pass through the air preheater and continue to travel downstream.

62. (previously presented) The method of claim 59, wherein the computer model models various parameters in the combustion system.

63. (currently amended) The method of claim 62, wherein the parameters include particle formation, temperature patterns, rates of reaction of components, and condensation reactions <u>of pollutants</u>.

Claim 64 (canceled)

65. (previously presented) The method of claim 62, wherein the parameters include the geometry of the combustion system.

66. (previously presented) A method of capturing gas phase pollutants in a combustion system comprising the step of:

creating a computer model of the combustion system that predicts the temperature gradient and location in the combustion system where the critical phenomena of condensation of gas phase pollutants occur;

using the computer model to configure the combustion system, including determining optimal distribution of particles and particle injection locations in the combustion system to enhance the heterogeneous condensation of gas phase pollutants onto the injected particles; and

injecting particles into the combustion system at one or more locations, wherein the size of the particles and the location of the injection are chosen such that pollutant condensation occurs primarily on the injected particles.

67. (previously presented) The method of claim 66, wherein the location of the injection are determined based on where pollutant condensation occurs in the combustion system.

68. (previously presented) The method of claim 66, wherein the chosen location of the injection are determined by measuring gas phase pollutant capture at various injection locations.

69. (previously presented) The method of claim 66, wherein the gas phase pollutants include sulfur trioxide.

70. (previously presented) The method of claim 69, wherein the temperature gradients within the air preheater are modified to increase the rate of sulfur trioxide condensation on ash particles as they pass through the air preheater and continue to travel downstream.

71. (previously presented) The method of claim 66, wherein the computer model models various parameters in the combustion system.

72. (currently amended) The method of claim 71, wherein the parameters include temperature patterns, rates of reaction of components, and condensation reactions <u>of pollutants</u>.

Claim 73 (canceled)

74. (previously presented) The method of claim 72, wherein the parameters include the geometry of the combustion system.

75. (previously presented) The method of claim 71, further comprising the step of using the computer model to determine optimal concentration and size of the particles to be injected.

76. (currently amended) The method of claim 66 , ~~where examples of gas phase pollutants include, but not limited to,~~ <u>wherein the gas phase pollutants captured in the combustion system include at least one of</u> Sulfur trioxide, Mercury, and other volatile elements , inorganic and organic compounds.

77. (previously presented) A method of capturing gas phase pollutants in a combustion system downstream of a combustion zone comprising the steps of:

creating a computer model of the combustion system that predicts the temperature gradient and location in the combustion system where the critical phenomena of condensation of the gas phase pollutants occur;

using the computer model to determine optimal size distribution of particles and locations to inject particles into the combustion system to enhance heterogeneous condensation of gas phase pollutants onto the injected particles; and

injecting particles into the combustion system at one or more of the determined locations.

78. (previously presented)The method of claim 77, wherein the critical phenomena are enabled by providing zones in the combustion system with a temperature gradient chosen such that a temperature shift occurs from above the dew point of a particular gas phase pollutant to below its dew point and with sufficient nucleation sites present for the condensation reaction of the particular gas phase pollutant to occur.

79. (currently amended) The method of claim 78, wherein the size distribution of the injected particles is chosen such that the injected particles ~~are small enough to~~ provide sufficient nucleation sites for the condensation reaction to occur, and ~~large enough to~~ can be captured in a subsequent particulate control system in the combustion system.

80. (previously presented)The method of claim 77, wherein the gas phase pollutants include sulfur trioxide.

81. (previously presented)The method of claim 77, wherein the material of the injected particles is chosen such that it neutralizes the acidity of the sulfur trioxide.

82. (currently amended) The method of claim 81, wherein the material of the injected particles ~~comprises one or more of:~~ is selected from the group consisting of fly ash, finely ground

minerals, alkali compounds, alkaline-earth compounds, aerosols, and aqueous solutions of salts and mists.

83. (previously presented) The method of claim 77, wherein the temperature gradient is achieved by an air preheater that is modified or operated to increase the rate of sulfur trioxide condensation on ash particles as they pass through the air preheater and continue to travel downstream.

84. (previously presented) The method of claim 77, further comprising using the computer model to determine optimal concentration and size of the particles to be injected.

85. (previously presented) The method of claim 77, wherein the optimal locations are determined such that pollutant condensation occurs primarily on the injected particles.

86. (currently amended) The method of claim 77, ~~where examples of gas phase pollutants include, but not limited to,~~ wherein the gas phase pollutants captured in the combustion system include at least one of Sulfur trioxide, Mercury, and other volatile elements , inorganic and organic compounds.

87. (previously presented) The method of claim 77, wherein the computer model models various parameters in the combustion system.

88. (previously presented) The method of claim 87, wherein the parameters include temperature patterns, rates of reaction of components, and condensation reactions.

89. (previously presented)The method of claim 88, wherein the parameters include the geometry of the combustion system.

90. (previously presented)The method of claim 77, wherein the combustion system includes a furnace.

91. (new) The method of claim 59, wherein the computer model uses CFD–Fluent to predict temperature gradients, Chemkin to predict initial SO_3 and other pollutants' initial concentrations prior to an air preheater, ATRAN to predict ash size distribution of resulting ash particles, and GDE to predict the critical heterogeneous and homogeneous phenomenon and optimal location of injection of particulates.

92. (new) The method of claim 59, wherein the air preheater is operated to modify the temperature of the flue gas traveling through the air preheater and downstream ductwork.